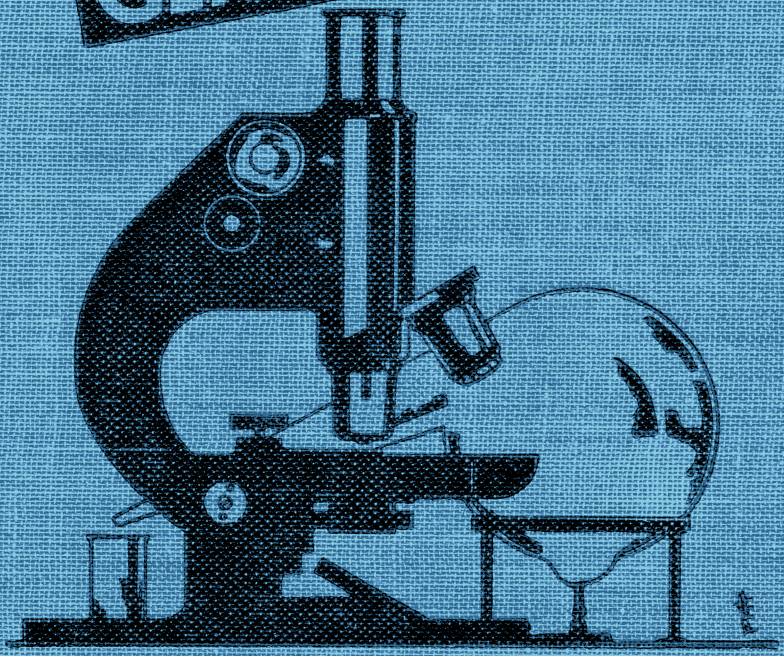
RAYON, NYLON and GLASS FIBERS



RAYON, NYLON, AND GLASS FIBERS

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COMPILED BY THE WORKERS OF THE WRITERS' PROGRAM OF THE WORK PROJECTS ADMINISTRATION IN THE COMMONWEALTH OF PENNSYLVANIA

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FOREWORD

Rayon, Nylon, and Glass Fibers is the thirty-seventh book in the Easy Science Series. It was prepared by the Pennsylvania Writers' Project which is sponsored by the Pennsylvania Department of Public Instruction. Credit is due and granted to the various editors of the project for their work and cooperation in the preparation of the manuscript for this booklet. The illustrations were prepared by the artists of the Pennsylvania Art Project.

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J. KNOX MILLIGAN
State Supervisor

PRIMITIVE WEAVING

RAYON, NYLON AND GLASS FIBERS

Cinderella would scarcely need a fairy godmother's magic to make her a party dress today. She could go to the ball dressed in a lovely gown made from fabrics which have been created for us by the magic of modern chemistry and science.

Until a short time ago, cloth was made almost entirely from the fine, thread-like substances called fibers which are supplied to us by nature. All through the world's history, man has made use of these natural fibers; fibers which are found in the wool which grows on sheep, in linens from the flax plant, in silk from the silkworm, and in cotton from the cotton plant.

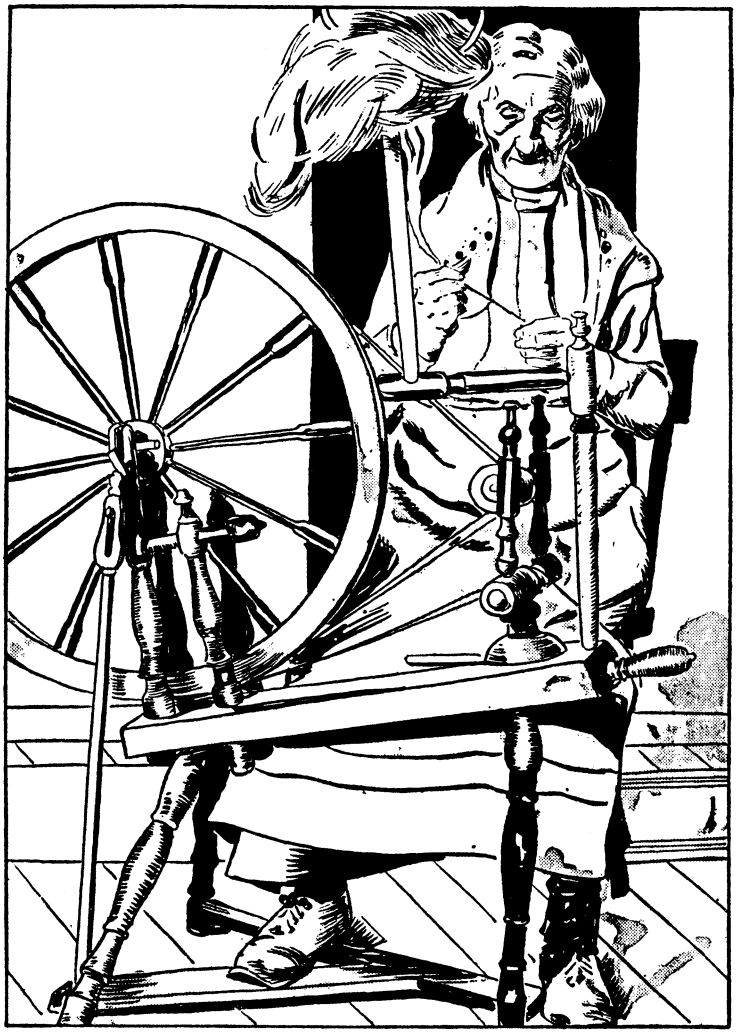
Thousands of years ago people learned to spin thread made from these natural

fibers, and to weave it into pieces large enough for many uses. Sometimes we think of these large pieces as cloth, whether they are made from cotton, wool, linen, or silk. These different cloths are also called textiles or fabrics. Silk is the most desired and the most expensive of these fabrics. This is because it takes many thousands of silkworms to produce even a yard of silk, and because so many workers are needed to care for the silkworms.

It was generally believed until recently that only nature could produce fibers. As man's scientific knowledge increased, he began to wonder if he could not make fibers for himself. He was specially interested in making silk fibers, believing that silk fabrics produced from man-made fibers would be less expensive than those made from natural fibers.

Man Attempts to Make Fibers

In 1710, a Frenchman named Reamur wrote a book about insects. He had



THOUSANDS OF YEARS AGO PEOPLE LEARNED TO SPIN

studied the silkworm and had discovered that silk was first formed in the worm's body as a gummy substance which was pressed out of the worm through tiny openings under its jaws. These openings he called spinnerets. He also observed that when the gummy substance was pressed through these spinnerets and came into contact with the air, it hardened and formed fine, long, shiny strands.

In his book, Reamur wrote: "Silk is only a liquid gum which has been dried. Could we not make silk ourselves with gums and resins?" He worked patiently to carry out this idea. In 1735 he succeeded in making a gummy substance like that made by the silkworms. It was a sort of varnish. He forced it through tiny holes like those in the worm's head, and although it hardened it was not quite right. It did not make good silk. The time had not yet come for man to make fibers.

More than a hundred years passed before another man, a Swedish chemist

REAMUR SUCCEEDED IN MAKING A GUMMY SUBSTANCE LIKE SILK

named Andemars, succeeded in making a silk-like pulp which would harden in air. To do this he dissolved the inner bark of the mulberry tree in alcohol and ether. But the fibers which he made were not quite right either. He could not sell his product. In 1883 an English scientist, J. W. Swan, tried to make fibers by still another method, but without success.

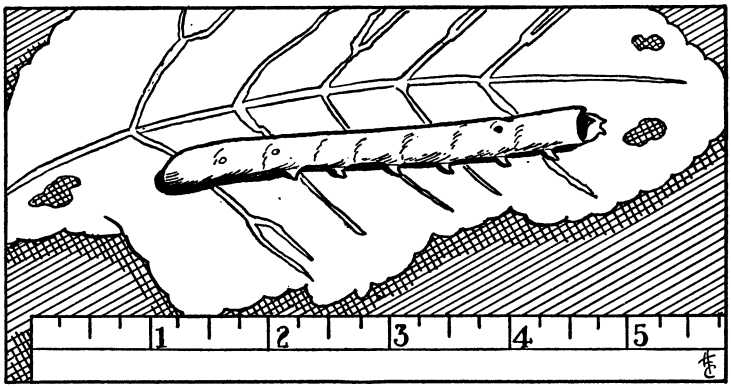
Two years later, Chardonnet, a Frenchman, took out a patent on a silk-making process which he had developed. He used cotton dissolved in ether. When this mixture met the air, it hardened into filaments just as the gum from the silkworms did. A satisfactory man-made fiber had been found at last! Chardonnet opened a factory in a French town and began to manufacture fabric from the fibers made by his process.

Man-made silk could now be produced more quickly and cheaply than real silk but there were many improvements to be made. Many other scientists worked

on the problem. Each added something to the fiber-making process. It was also necessary for man to learn to make good artificial spinnerets to do for his fibers what the spinnerets under the jaws of the silkworm do for natural fibers.

Cotton was used in most of the experiments in making fibers because it was plentiful and cheap. It was found that cotton waste, mixed with certain other substances, became a soft pulp which readily formed filaments as it left the man-made spinnerets. After the other chemicals were washed away, these filaments became long, fine threads, delightfully soft and shiny.

Real silk is shiny and soft too. Because of this, the new fibers were thought at first to be exactly like real silk fibers. It was soon discovered that they were actually as different from silk as silk is from cotton. While not quite so shiny and elastic as silk, the man-made fibers were almost as soft and had a more brilliant luster. The new fabric, woven



SILKWORMS FEED ON LEAVES OF PLANTS

from these fibers, was finally named RAYON, after the sun's rays which its luster suggested. Then too, like the sun, it could be enjoyed by everyone.

The Kinds of Rayon

Just as there is a variety of natural fibers, so there is a variety among man-made fibers. There are four main types of rayon. Before we learn what these

different types are, we should know what substances provide us with this wonderful new fabric.

Rayon is cellulose treated in such a way that it can be used as natural fibers are used. Cellulose is a starch-like substance obtained from plants. All plants contain this substance, but cellulose from some plants is better than that from others. Just as the silkworm eats the leaves of a plant and makes them into silk, so cotton which grows as a plant provides the best cellulose for making rayon. In nature, animals and plants take the steps which produce silk. When men manufacture rayon, they follow careful scientific processes.

The first type of rayon we want to learn of is made by a process which uses a substance called nitric acid. This process produces nitrocellulose. Under certain conditions of heat, moisture, and handling, nitrocellulose can be made into rayon. Under other conditions, it may become dynamite. Nitrocellulose is

handled very carefully. Since better methods for making fibers have been found, nitrocellulose is seldom used now for producing rayon.

In another process, cellulose is mixed with special forms of ammonia and copper. When the ammonia and copper method is used to make rayon, the cellulose is passed through the spinnerets into a special fluid. The rayon filaments will form only in this fluid. Very little rayon is made today by this method because it is so very difficult.

A third method combines the cellulose with a special chemical. The result is called cellulose acetate. While this method is not the most popular one in use today, its usefulness in making fabrics with certain specific qualities is very great. It is possible to produce waterproof fabrics by this method.

The fourth method, known as the viscose method, is now used to produce most of the world's rayon. It gets its name from the appearance of the substance at

one step in the process. When certain materials are mixed with cellulose, a mass results which is thick, dark, and syrupy. Since such a mass is said to be "viscous," the name viscose is used.

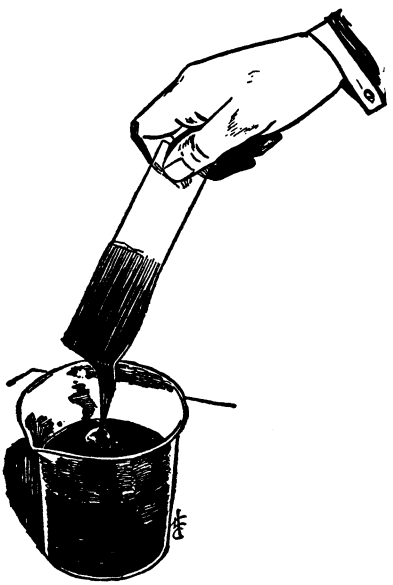
How Rayon Is Made

It costs a great deal to turn cotton into cellulose. In searching for a less costly material, it was discovered that wood was just as suitable as cotton because trees, like all plants, contain cellulose. Spruce was found to be the best kind of wood to use. Wood pulp, made from the spruce trees, is mixed with cotton linters. These are the short fibers still clinging to the cotton seed after the long fibers have been removed. They are dark and do not look much like cotton, but they contain as much cellulose and are very much less expensive. Viscose rayon is made from such a mixture.

Thousands of spruce trees are cut down every year and transformed into cloth. Let us see what happens to a spruce tree from the time it is cut down in the forest until it appears in a store in the form of rayon.

First, the felled tree is chopped into sections. These are taken to a mill and sawed into smaller lengths. At the mill the wood is placed in great vats called digesters. These take out everything but the cellulose. This is done by boiling the wood in live steam and mixing it with caustic soda. Live steam is steam which comes directly from the boiler. Caustic soda, or lye, is a solid white substance used in making soap. This treatment causes the wood fibers to swell and loosens them from the other materials in the wood. The cellulose is then washed until everything else has been removed.

After the washing process is completed, the cellulose is bleached until it is a mass of short, white fibers. These are passed



CELLULOSE MIXED WITH CERTAIN MATERIALS
RESULTS IN VISCOSE

through rollers which press out the water. They act like the wringer on a washing machine. From these rollers huge sheets of material which look like pale blotting paper appear. These are one of the purest forms of cellulose.

The cellulose is then cut into smaller pieces and treated with various liquid substances. This treatment takes two or three days. At the end of this time, a viscous mass has been produced. This mass is then aged for a certain length of time in large vats. It is then filtered, cleaned, and sent through pipes to the spinnery room.

In the spinnery room, the viscose is forced through spinnerets. Man developed spinnerets to do for his fibers what the spinnerets of the silkworm do for real silk. As now used, these are small metal or glass plates, each containing fourteen or more holes so small that they cannot be seen by the naked eye. It is hard even to imagine such tiny holes. Thousands of them laid in rows

THOUSANDS OF SPRUCE TREES ARE CUT DOWN EACH YEAR

would not make a square inch. Since even a speck of dust will clog a hole completely, great care is taken to keep them very clean.

From each tiny hole in the spinneret a continuous, smooth filament appears. These are finer that a single strand of a spider's web. These fine threads pass from the spinneret into a special chemical bath which acts upon the viscose as air does on the silkworm's gum, causing it to harden into a fiber.

At this point in the process there are two different methods of handling the filaments. In one method, they are wound on spools that go round and round, pulling the filaments out of the hardening solution. After they are washed and dried, groups of them are twisted into thread. It takes from fifteen to twenty filaments to make a thread strong enough for weaving.

The other method gathers up the filaments as they appear from the spinneret and twists them together. This is done before they are washed and dried. This process produces a stronger fiber and saves an extra step in making rayon. By moving up and down and round and round at the same time, the filaments are pulled and twisted into yarn.

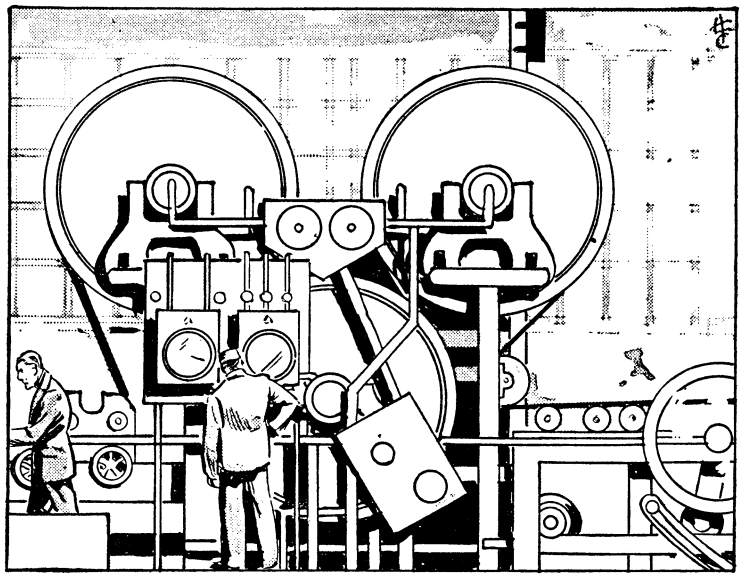
Through each step in making rayon, everything must be done carefully and exactly. A small difference in temperature or a tiny mistake in the quantity of any substance used, may spoil a whole batch of the finished product. Workmen

are constantly watching to keep the materials moving properly step by step. Small quantities from each batch manufactured are tested frequently to make certain nothing goes wrong.

Rayon Yarn

After the viscose thread has been treated by either of the two methods we have just learned about, it becomes rayon yarn. The yarn is wound into skeins which are easier to handle through all the manufacturing steps yet to be taken. Washing and drying are very important. By the time this has been done, the pure cellulose, which at first seemed to look like a sheet of pale blotting paper, has been transformed into coils of shining thread. It can then be recognized as rayon.

Rayon, like wool or other fibers, is measured by the number of yards in a pound of yarn. This, of course, depends upon the number of filaments and of twists. The more filaments, the thicker



MOST OF THE QUALITIES OF RAYON CAN BE CONTROLLED BY MACHINERY

the thread; and the more the twists, the stronger the thread. This is because twisting holds the fibers tightly together and several fibers together are, of course, stronger than a single fiber.

Most of the qualities of rayon can be controlled by means of machinery. Any type of rayon desired may be produced. Sometimes long filaments of either vis-

cose or acetate rayon are cut into short ones all the same length and then spun together. This is called spun rayon yarn.

From this yarn can be made cloth which looks like cotton, woolen, or linen fabric. The long or continuous filaments make a shiny fabric which looks like silk. The fibers in continuous-filament yarn are stronger than those of the same size made into spun rayon yarn. Sometimes rayon filaments are given special shapes or sizes by forming them in spinnerets which have been specially made to produce the special shape. In this manner, rayon straw and rayon horsehair are made.

Examining and Grading

Mistakes can occur in making rayon, of course, as they can in making anything else. To overcome these mistakes, every skein or hank, which is two or more skeins, of rayon is carefully inspected. Flaws are quickly found. If no flaws appear in a skein or hank, it

is marked "Grade A." This is used for the finest materials. If there are very slight flaws, the rayon is marked "Grade B." Materials which are not weakened by such flaws are made from this grade. Third grade "C" is also permitted to pass, and is used in certain other types of materials.

If the rayon cannot be put into any of these three grades, it is sent back to the beginning of the manufacturing process to be made over. It is boiled down until only pure cellulose remains. Then the whole process must be repeated until it becomes rayon again. Rayon workers are trained to be very careful, however, and comparatively little of such flawed material appears.

Combinations and Colorings

Rayon thread is very often combined with one or more other fibers. Silk-and-rayon and cotton-and-rayon combinations are common. Each has particular qualities. Wool is warm and rayon is shiny.

Therefore, if a warm and shiny blanket is desired, wool-and-rayon are just the things to use. Silk-and-rayon or linen-and-rayon combinations produce other attractive and useful results. In some cases the high cost of the natural silk and linen is balanced by low-cost rayon. Yet the finished garment has the good qualities of both the natural and the artificial fibers.

Some pretty colors are found in rayon combined with other fibers. A certain method of coloring or dyeing cotton will produce one shade. Used on rayon, this same dye may make another shade. A cloth partly rayon and partly cotton will then have two different shades as the result of one single dye bath.

Lately there have been many improvements in dyeing all kinds of cloth. Rayon takes dyes very well and can be given almost any color, but the dyes used must be specially prepared because of the special texture of rayon fabrics. Many of the colors used for dyeing rayon will not fade, even in the sun.

The Usefulness of Rayon

Rayon is popular because it costs much less than silk, yet has the same softness. If it is given the same care, it usually lasts as long as cloth made from natural fibers. Sometimes it lasts even longer. Rayon cloth can be washed and cleaned as easily as cotton cloth. We need only to remember to treat rayon gently while it is wet. Wet rayon is weaker than other wet fabrics but once dry again, it is as strong as ever. Besides this, white rayon never turns yellow with age as does white silk.

For these and other reasons, rayon has become one of the most useful and popular of all fabrics. It is used in all sorts of garments from silky underwear to topcoats which resemble suede or velvet. Curtains and other house furnishings are often made of rayon alone, or combined with other fabrics. The shine of rayon is easily seen against the dull twist of cotton, linen, or wool with which it is mixed.

RAYON WORKERS ARE TRAINED TO BE VERY CAREFUL

By working together, scientists have created the important new rayon industry within the past fifty years. France was the first country to produce rayon filament yarn commercially. Belgium, Germany, and Great Britain were also pioneers in the rayon industry.

The United States started the commercial production of rayon in 1911 and increased it steadily until 1919, when we were producing more rayon than any other country in the world. By 1938 there were twenty-two countries manufacturing rayon. The United States leads them all.

Rayon manufacture has become the third most important textile industry in the world. Only the manufacture of cotton and wool are of greater importance. Every year more people are able to afford rayon because the more of it produced, the less it costs. The number of people employed today in rayon factories will undoubtedly be increased as

new uses and new demands are found for this wonder fabric made entirely by man.

Nylon

Rayon is not the only man-made fiber which may be used for making fabrics. We know that once people understood and began to use the processes of making fibers from cellulose, scientists began experimenting with other substances which would make either better or more beautiful fabrics.

To help accomplish this purpose, scientists have been trying for a long time to discover what caused one natural form of matter to change into another form. They became especially interested in coal. They knew, as did most everyone, how trees and other plants of earlier ages had died and became embedded in the earth. They knew that centuries of heat and pressure had changed the cellulose of these plants into the black, rock-like substance that is coal. They had also

learned that in a combination of coal, air, and water would be found all the substances contained in real silk. These are carbon, hydrogen, oxygen, and nitrogen.

Scientists are never satisfied with the natural action of substances. They like to make them do strange, new things, so they began to make coal do strange things too. By using very great heat and pressure, as nature did, they worked out ways of making changes but in much shorter time than nature requires. They discovered how to change parts of the coal into alcohol, parts into ammonia, and parts into still other substances. By 1942 more than one hundred different articles were being made from coal.

The scientists also began a series of experiments with coal, water, and air. Certain substances taken from coal were mixed with certain parts of air and water, and a new substance was formed. From it a new fabric was made. It was named NYLON.

The Qualities of Nylon

Nylon has great strength and toughness. It is also very elastic or stretchable. It is different from any other fiber in that it may be given a certain shape by using moisture and great heat and pressure. No matter how much it is stretched, it always comes back to its first or original shape. The only way to change its shape permanently is to treat it with even greater heat and pressure.

Because of its ability to hold its shape, some one thought of an especially good use for nylon. Why not make women's stockings of it? Nylon stockings would never lose their shape as long as they lasted. The idea was quickly accepted by manufacturers, and nylon stockings soon appeared in the stores. People like them very much.

The Manufacture of Nylon

Most nylon is made from two chemicals. One is found in bituminous or soft coal,

and one contains ammonia and carbolic acid. Other raw materials could be used for making nylon, but coal is preferred because it is easy to get and inexpensive.

These two chemicals are heated together to a certain temperature and the substance from which nylon is made begins to form. It becomes a viscous mass something like that from which rayon is made. It is forced through spinnerets in the same way. The nylon filaments, however, need further treatment. They must be pulled gently but firmly into the shape they are to keep.

Nylon Compared to Other Fibers

Many different things can be made of nylon fibers. The fibers themselves may be made into many thicknesses. They can be made as fine as silk or as coarse as hog bristles. It is also possible for them to be like fine cord. Nylon dyes as easily as other fibers. It combines easily with other fibers. It can be

crimped, or roughened, to look like wool or it may be made as smooth as satin. It can be either shiny or dull. It is easily cleaned. Moths will not eat it as they do wool.

The Uses of Nylon

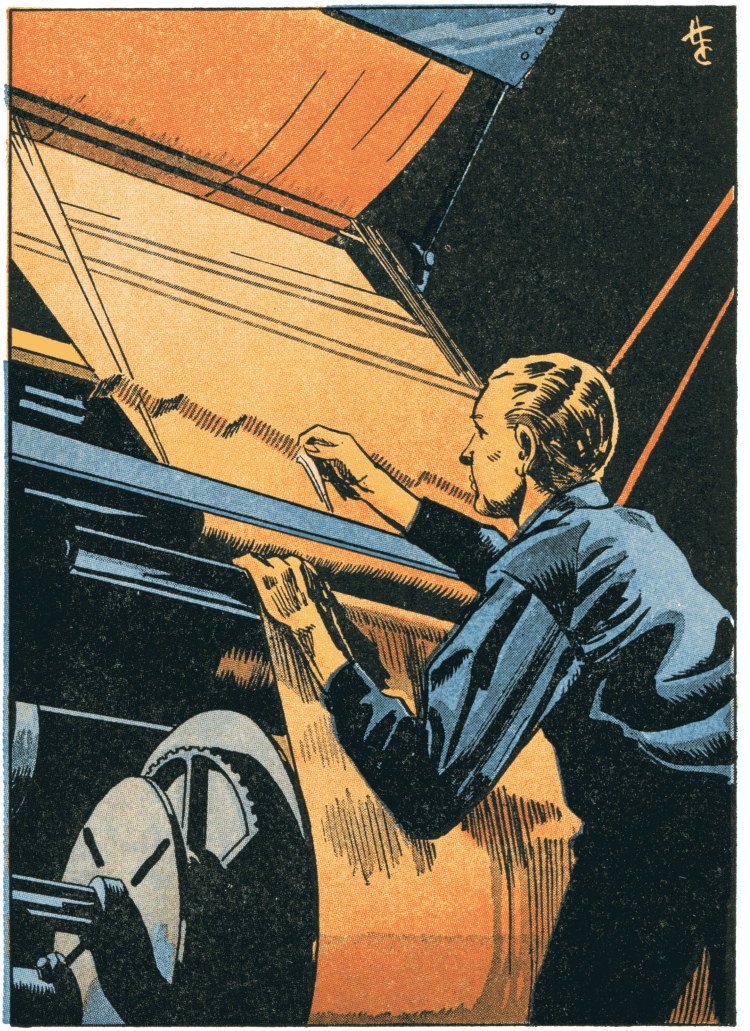
Great sums of money and long hours have been spent to find out what nylon can do. Here are a few of the things already known. Nylon crimped to look like wool is good insulation against weather. This means that neither heat nor cold can get through it. When placed between the walls and the floor boards of a house, it keeps out the cold in winter and the heat in summer.

It makes a good electrical insulation. Electricity burns, shocks, and sometimes even kills people. Any article "charged" as we say with electricity must be covered with insulation to protect against possible injury. An electrical insulator is a substance or material used to cover the metal through which electricity

passes. The electricity cannot pass through the insulation.

Nylon insulation may be either nylon yarn wrapped about the electric wires, or it may be a film of nylon solution covering or enameling the wires. This nylon enamel is used a great deal on small electric motors found in homes and factories.

There are other uses for nylon which is not in fabric form. It is sometimes made into thick and thin sheets. It can be pressed through wide slots and used for belts and suspenders. It may also be used for toothbrush and hairbrush bristles, sewing thread, fishing lines, strings for tennis rackets, and all sorts of straps and cords. It has been successfully used for parachutes, parachute cords, and glider tow lines by the airmen of our country. New ways of using it are being found all the time. With all these many uses, it is easy to understand how this new man-made material has, in just a few years, become part of the American way of living.



PRETTY COLORS ARE FOUND IN RAYON COMBINED WITH OTHER FIBERS

Now that we have seen how nylon is produced from that wonderful product of nature — coal, let us examine three other new ways of producing fibers from other natural products. These are known as vinyon, lanitol, and aralac. We will discuss vinyon first.

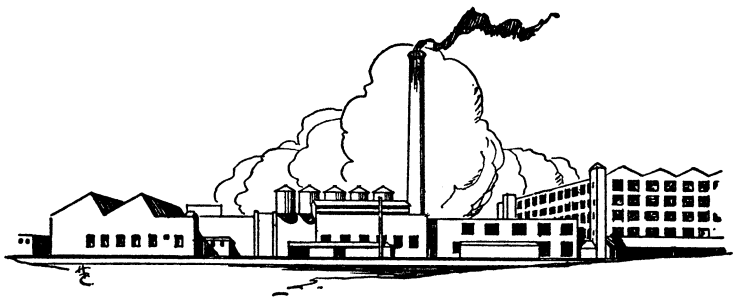
Along with coal, scientists have long been studying natural gas. Like air, it cannot be seen under ordinary conditions but like coal, it gives off heat, light, and energy when burned. The special name of the most familiar hydrocarbon — that is, a combination of hydrogen and carbon — derived from natural gas is vinylene. From this comes the name for another of our new man-made fibers — VINYON.

More than a hundred years ago, a man name Renault made some experiments with vinyl compounds. Records of his work show that he succeeded in making what he called vinyl "serum." However, the making of vinyon had to rest

with the development of the serum until other steps had been improved. Rayon and nylon manufacture showed the way. We now have fibers made from natural gas as well as of cellulose and of coal.

Vinyon is a combination of special substances from natural gas and coal, salt, air, and water. The early steps in making vinyon, as in the making of other fibers, are complicated and delicate processes. Certain substances and materials must be mixed with great care and under very special conditions of heat and moisture. The resulting fibers appear from spinnerets. Vinyon, like nylon, may also be produced in the form of sheets or ribbons.

Vinyon is different from other man-made fibers in certain ways but it is just as adaptable as the others. This means that it can be used in making as many different things. Vinyon, however, cannot be used in materials that are to be near heat. If made hotter than a certain temperature, vinyon will



A TYPICAL RAYON FACTORY

melt, or fuse, and its threads become a mass again. Sometimes this quality is an advantage. Because of it, vinyon may be used to give warning when heat becomes too great. Vinyon itself will not burn; it only melts.

It is also waterproof, although in hot water it stretches like rubber. Like nylon, it is not easily affected by acids, nor does it rust easily. When crimped to look like wool, vinyon, like nylon, can be used to control the temperature of a building. The rays of the sun do not cause it to lose its strength. It may easily be seen how useful vinyon is for making certain articles.

One place in which vinyon is valuable is in factories and laboratories where chemists and other workers handle acids and alkalies. The workers may be protected from both by garments made of vinyon. People who work near fire or in damp places also find vinyon garments very good.

Vinyon fibers are used as other artificial fibers. They are combined with the natural fibers of wool, silk, cotton, and linen. They may be woven and braided into textiles and used as insulation for electric wires. Shower curtains, fishing lines, and sail cloth are also made of vinyon because it is waterproof. Awnings, furniture covers, and draperies are made of it because it is not harmed by the sun.

Let us examine a vinyon shower curtain. It is waterproof, of course. It may be a bright and pretty color. It is shiny and germproof. The folds into which it is pressed will always stay in place. If it is splashed with rubbing alcohol, it

will not be harmed. Thus vinyon makes an almost perfect shower curtain.

Vinyon makes excellent strainers or filters. This is because liquids go between the threads of vinyon fabric quickly without wetting the fabric itself. Its close weave holds back the smallest thing which should not be in the liquid. We call this filtering. Since the vinyon filters remain dry, they are easily cleaned. Therefore, they are welcomed in many industries.

Other Special Fibers

Textiles have been made from cellulose, from a mixture of coal, air, and water, and from natural gas. All of them are unusual but imagine cloth made from silk! It sounds unbelievable, and yet it has been done. In 1935, scientists announced that they had succeeded in making a fiber out of milk. The new fiber was named LANITOL. It was produced from that part of the milk called casein. Lanitol fibers have not yet been made in great quantities.

Still another process has been discovered for making fibers out of the casein of milk. Scientists discovered the method while studying dairy products. The initials of the scientists' association are A. R. A. "Lac" comes from the Latin word for milk. The six letters put together provided a name for these new fibers — ARALAC.

Although it is too early to know for sure, it appears that aralac may soon take its place beside rayon. A textile has already appeared which was made half of rayon and half of aralac.

Fiberglas

We were surprised that fibers could be made by man from milk. So would not the making by man of fibers suitable for weaving from glass surprise us too? It's true! Such fibers are made from glass.

Every one is familiar with such glass articles as drinking tumblers and window panes. Some of us have seen the glass

bricks used in our newest houses. But just imagine a glass dress. It does seem like something out of a fairy tale. It is a fact, however, that as far back as a thousand years ago, people knew how to make fibers out of glass.

True, these early glass fibers would not bend without cracking or breaking. In other words, they were not flexible. The first flexible glass fibers were made in Germany a hundred years ago. Glass fibers that could be used in textiles were first made in this country about ten years ago. Cloth was woven of beautifully-colored, glistening glass. The fabric was as smooth and soft as silk.

In making glass fibers, as in making other glass, quantities of the purest, cleanest sand are mixed with certain other materials. This mixture is cooked over very great heat until the materials melt or fuse. This molten mass is drawn out into fine, seemingly endless filaments. In many ways this pulling process might remind one of pulling taffy.

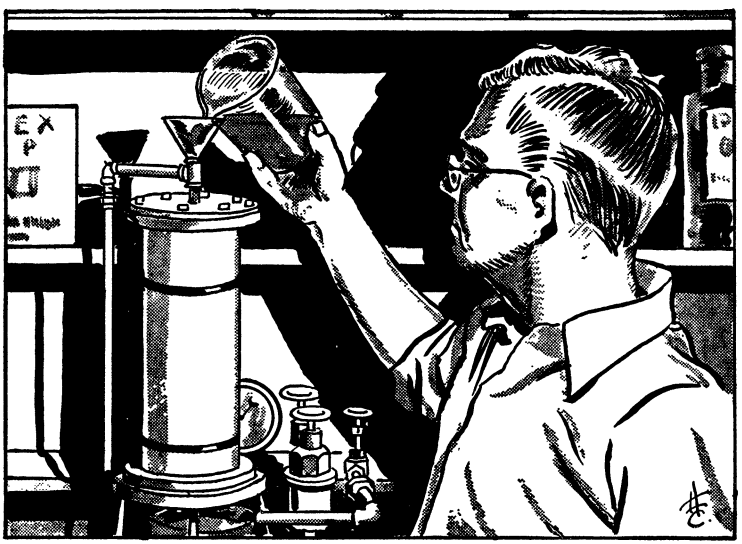
WET RAYON IS WEAKER THAN OTHER WET FABRICS

The newest method of making these filaments is to use glass shaped into marbles. These marbles are fed into a furnace heated by electricity. The intense heat melts the marbles and the molten mass falls through a plate in which there are 102 tiny holes. From this plate comes 102 tiny filaments which are twisted together to form one strand of thread.

Another process makes even finer and more elastic filaments. Glass marbles are used in this process also. In this method, however, the molten glass is blown downward onto the plate by steam; while in the first process it merely falls down or, to be more correct, is drawn down by gravity. As the filaments come from the plate a special winding and pulling machine gathers the groups of filaments into threads and twists them gently. Long fibers are used mostly for making cloth. Each fiber is about one-fifteenth the thickness of a human hair.

All through the steps of making glass fibers, a special oil is used. It keeps the fibers from scratching one another. Few materials can scratch glass, but one glass fiber may injure another and cause it to break. That is why the oil is used while the fibers are being drawn and woven. Afterwards the oil is washed away.

Yarns made of glass fibers are woven into many different articles. Among



SCIENTISTS MADE A FABRIC OUT OF MILK

them are tapes and cords for electrical insulation.

The fabric made from the glass fibers is called FIBERGLAS. It is solidly woven, smooth, and may be made in any color. The dyes are added to the fibers before spinning. It is water and fireproof and unaffected by heat, moisture, and most acids. It cannot be eaten by moths and will not rot. Fiberglas is very strong, soft, and flexible. It is used for draperies, upholstery fabrics, and curtains. Since it is waterproof, it makes excellent shower curtains. Because it is fireproof, it is also used for theater curtains. Fiberglas is also an important material in aiding air conditioning systems to function more perfectly.

As yet, Fiberglas is not often made into clothing, except into small articles like neckties. This is because it is much heavier than fabrics made of other fibers. The day may come when glass can be made into fibers light and fine enough to make comfortable garments.

Scientists have done much and made many things with their magic. Fibers made by man are appearing so rapidly that one scarcely knows what will come next. These developments have provided us with fine, comfortable clothing at moderate cost. Certainly man's long dream of producing fibers which would permit the manufacture of textiles for less than those made from natural fibers has been realized. Moreover, the cost is relatively unimportant when one considers the many advantages man-made fibers possess.

The developments which have made man-made fibers possible have released us from our dependence upon nature for a supply of textile fibers. Man has learned to make his own, and will keep on learning. All of the efforts of Cinderella's fairy godmother could not possibly equal man's efforts, and could not have produced as beautiful fabrics as we are

now able to make from man-made fibers. Exciting as these are today, the fabrics of the future are certain to be even more wonderful.